Discrete Mathematics and Data Science Research Team Seminars

All seminars are held at 15:10-16:00 in Room M/1.02, Senghennydd Road, Cardiff unless stated otherwise.

Programme Coordinators:

Dr Iskander Aliev (MATHS), Dr P. Corcoran (COMPS) and Dr A. Gagarin(MATHS/COMPS)

Date	Speaker	Seminar
8 May 2018	Prof. Joerg Fliege (University of Southampton)	Finding optimal flight plans for satellites and other spacecrafts In recent years, spacecraft navigation and control has achieved astonishing feats. As a recent example, the journey of the Rosetta craft through the inner Solar System lasted ten years, covered 6.4 billion kilometres, and is presently still in progress since the lander Philae landed on comet 67P on 15th of November 2014. In this talk, we highlight some of the difficulties of planning corresponding flight paths of future missions in an optimal fashion, present some of the underlying

Date	Speaker	Seminar
		mathematical models, and discuss methods from mathematical optimization that help to attain such amazing accomplishments.
12 December 2017	Prof. Anthony C. Atkinson (LSE)	Robust Constrained Clustering In cluster analysis the data are divided into k groups of similar individuals, with k a parameter to be estimated. In model-based clustering (we assume clusters of normally distributed observations) the likelihood of the observations is maximised for a range of values of k. A penalty for complexity, typically the Bayesian Information Criterion (BIC), is then used to choose the number of clusters. These classification/mixture likelihoods are unbounded, so it is necessary to modify the problem. We introduce a constraint that the maximal ratio between the eigenvalues of the

Date	Speaker	Seminar
		scatter matrices be less than a constant c = 1. This avoids threadlike clusters. We introduce a new penalised likelihood criterion, generalising BIC, which takes into account the higher model complexity possible with large values of c. We extend this analysis to outlying observations which should not be forced to belong to one of the multivariate normal clusters. This robustness is achieved by trimming a proportion a of the observations. Of course, a is unknown. We therefore monitor analyses over a range of values of a. Our aim is to select optimum values of k, c and a. Our major example uses data on 424 cows with bovine phlegmon. In addition to presenting a final clustering, we use plots to illustrate the stability of the proposed solution.

Date	Speaker	Seminar
		The talk is based on a joint work with Marco Riani (University of Parma).
1 November 2017	Prof Jacek Gondzio (University of Edinburgh)	Continuation in Optimization: From Interior Point Methods to Big Data In this talk we will discuss similarities between two homotopy-based approaches: 1. (inexact) primal-dual interior point method for LP/QP, and 2. preconditioned Newton conjugate gradient method for big data optimization. Both approaches rely on clever exploitation of the curvature of optimized functions and deliver efficient techniques for solving optimization problems of unprecedented sizes. We will address both theoretical and practical aspects of these methods applied to solve various inverse problems arising in signal processing.

Date	Speaker	Seminar

Part of this work was done jointly with my former PhD student, Kimonas Fountoulakis.

References:

J. Gondzio, Convergence analysis of an inexact feasible interior point method for convex quadratic programming, SIAM Journal on Optimization 23 (2013) No 3, pp. 1510-1527. DOI: 10.1137/120886017

J. Gondzio, Interior point methods 25 years later, European Journal of Operational Research 218 (2012) pp. 587--601. DOI: 10.1016/j.ejor.2011.09.017

I. Dassios, K. Fountoulakis and J. Gondzio, A preconditioner for a primal-dual Newton conjugate gradients method for compressed sensing problems, SIAM Journal on Scientific Computing 37 (2016) A2783--A2812. DOI:

Date	Speaker	Seminar
		10.1137/141002062 K. Fountoulakis and J. Gondzio, A second-order method for strongly convex L1-regularization problems, Mathematical Programming 156 (2016), pp. 189--219. DOI: 10.1007/s10107-015-0875-4
24 October 2017	Bailin Deng (School of Computer Science and Informatics at Cardiff University)	Geometry Processing for Design and Fabrication Abstract: In the past few decades, advances in digital design tools have made it possible to create complex 3D shapes on a computer. However, physical realisation of these shapes remains a challenging task. Recently, the emergence of affordable fabrication tools such as 3Dprinters and laser cutters allows us to turn a digital design into a physical object. But effective use of these tools requires the design shape to satisfy certain requirements related to the fabrication technologies,

Date	Speaker	Seminar
		which are not considered by traditional 3D design tools. We argue that these fabrication requirements can be incorporated into the design process as geometric constraints, such that the resulting designs can be realised using designated technologies and materials. Wewill present a few fabrication-aware design tools for different applications, and show how geometry knowledge can help to solve challenging design problems.